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Sulfonated Hydrocarbon Graft Architectures for Fuel Cell Membranes

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Proton exchange membrane fuel cells (PEMFC) are gaining interest as an alternative power generator to the internal combustion engine, due to low potential energy loss, strongly reduced local pollution, and as a non-fossil fuel solution to the automotive industry. The technology is even more appealing in countries, like Denmark, where the primary storage of excess energy produced from renewable resources is that of electrolysis-generated hydrogen.

The electrochemical reaction between hydrogen and oxygen occurs over the polymer-based PEM. Important features of this include *i*) Proton conductivity, *ii*) chemical, mechanical and thermal stability under harsh conditions, and *iii*) gas impermeability. As the migration of protons takes place through ionic channels made up by e.g. sulfonic acid (-SO_3H) it is crucial to ensure the right balance between hydrophobic support and ionic ion conducting groups when designing PEMs.

Most commercial membranes are perfluorosulfonic acids (PFSAs) but these suffer from drawbacks at elevated temperatures and are expensive to produce. Multiple different approaches are being applied in the search for an optimized PEM. For instance, research published on alternate graft systems comprises an aliphatic fluorous backbone with sulfonated polystyrene (SPS) side chains[1] and a polysulfone (PSU) backbone with aromatic fluorous side chains[2].

The present work is investigating a non-fluorous graft system based on a PSU backbone with SPS side chains. The PS chains are clicked onto the PSU by the copper catalyzed azide-alkyne cycloaddition (CuAAC)[3] and are subsequently sulfonated. Films are cast and evaluated from standard PEM parameters like proton conductivity, water uptake and ion exchange capacity (IEC).

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